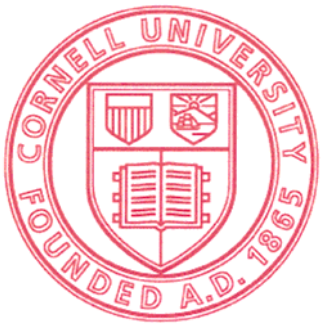
College of Agriculture and Life Sciences

2012—2013

Research Honors Program Abstracts



The College of Agriculture and Life Sciences (CALS) is considered among the finest of its kind in the nation, if not the world. As the land-grant college of agriculture and life science of New York State, our mission is to discover, integrate, disseminate, and apply knowledge with a public purpose in the life sciences, environmental sciences, food and energy systems, and economic and community vitality, as a basis for sustainable improvement in the lives of people throughout New York, across the country, and around the world.

Nothing is more critical to the success of the college's mission than an engaged and inspired student body, as exemplified by the students who earn a bachelor's degree with honors. The 2012-2013 honors thesis projects described in this booklet demonstrate an impressive capacity for personal dedication, mature scholarship and intellectual growth. The original research contained herein examines some of the most pressing and relevant questions of our time.

Many students consider the research projects they undertake as undergraduates in CALS to be among the most challenging, enduring, and rewarding experiences of their time at Cornell. As a faculty member, I have witnessed first-hand among my own advisees the formative impact that undergraduate research can have on budding young scientists. As dean, I am dedicated to fostering the college's unwavering commitment to providing our undergraduates with these life-changing research opportunities.

I am extremely proud of our undergraduate students and their achievements, and I wish them the very best in their future endeavors. I am also proud of the dedicated faculty who supervised these honors research projects and mentored these students to their fullest potential. As you will see from reading the following abstracts, these new graduates will soon take their place among tomorrow's scientific leaders and innovators.

Kathryn J. Boor, Ph.D.
The Ronald P. Lynch Dean of
Agriculture and Life Sciences

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An Exploration of the TnsE-Mediated Transposition Pathway of Transposon Tn7 Focusing on the Role of the Conserved Region of TnsE Between Amino Acids 290 and 304

DANIEL W. ACKER

Under the supervision of Dr. Joseph E. Peters
Department of Microbiology

Transposons are mobile DNA elements capable of moving between locations within the DNAs of its host. Among transposons, Tn7 is capable of a particularly high rate of transposition because of its dual transposition targeting pathways. One of these pathways, mediated by TnsD, targets the highly conserved *attTn7* site. The other pathway, mediated by TnsE, targets sites of lagging strand DNA synthesis. Through these two pathways, Tn7 is able to insert into new hosts without disrupting host gene function and while maintaining its mobility. The TnsE-mediated pathway, however, is poorly understood. In order to gain insight into the mechanism of this pathway, we have endeavored to assess transposition frequency in a set of mutant TnsEs with a focus on mutations in the region between amino acids 290 and 304. This region is highly conserved and is a putative SeqA interacting site. In a preliminary transposition assay, we identified what appeared to be a gain of activity mutation in this region. This, however, could not be verified because the TnsE mutant appeared to rapidly acquire mutations that suppress transposition function. To avoid the acquisition of suppressor mutations, we attempted to transfer this and other mutations of interest to a low copy number vector. This has proven to be more challenging than expected, and is not yet accomplished. However, in this work we were able to construct a vector for sub-cloning that should be useful in the future. In addition, we were able to sub-clone three interesting alleles into the low expression vector.

Generation and Characterization of Xylanases for Improved Feedstuff Nutrient Utilization

KAITLIN C. CHOU

Under the supervision of Dr. Xingen Lei
Department of Animal Science

Exogenous enzymes have been studied for their abilities to improve nutrient utilization and digestibility of various animal feeds. Actinobacteria like *Streptomyces fradiae* are capable of producing enzymes that have the potential to be used for these agricultural purposes. The objective of this study was to effectively clone, express, and assess the activity of two xylanase enzymes such that future experimentation can implement the expression techniques and utilize the enzyme to improve nutrient utilization in agricultural feed. Two xylanase genes found in the unofficial genome sequence for *S. fradiae* prepared by the laboratory, with the unofficial names peg797 and peg4182, were PCR amplified and ligated into pPICZαA expression vectors. The vectors were replicated in *E. coli* DH5α, extracted, and sequenced to confirm the genes were accurate and without mutation. The vectors were subsequently cloned into *P. pastoris* X-33 and extracellular expression of the enzymes

was induced. Activity of the xylanases was assessed qualitatively and quantitatively, with qualitative analysis yielding no conclusive results regarding the presence of activity. Quantitative analysis demonstrated that peg797 did not have any activity under present reaction conditions, and that peg4182 had higher activity than a commercially available enzyme. Low activity in peg797 could potentially be due to improper protein folding or improper reaction conditions, and requires further study.

Investigating Loci Controlling Body Size in the Domestic Rabbit (*Oryctolagus cuniculus*)

MOLLY A. FISHER

Under the supervision of Dr. Nathan B. Sutter
Department of Clinical Sciences

The domestic rabbit has many purposes: meat, fur, showing, research, and pets. This makes it important to understand rabbit biology. The rabbit, like most other domestic mammals, displays a wide range of body sizes within the single species. For example, Britannia Petites weigh two pounds at maturity while Flemish Giants weigh 15-20 pounds. This research sought to quantify size variation in rabbits of diverse breeds and utilize the size phenotype to explore the genetic basis for size variation. Hair samples and body measures from rabbits of all recognized U.S. breeds were collected. Principal component (PC) analysis was completed on the body measures. A measure of overall body size was provided by PC1, where the breeds were ranked by size. PC2 provides a measure of overall body shape. Whole genome sequencing was performed on one large and one small rabbit in order to compare with the reference genome and discover loci controlling body size. Using the genome analysis toolkit, 16,658,087 single nucleotide polymorphisms (SNPs) and 2,735,766 insertions/deletions (indels) variations were discovered. Taking a candidate gene approach, most of 34,567 variants that intersect genes with associations to human height variation were visually scanned. The differences found were analyzed based upon severity of the putative change in genetic sequence. One interesting indel is found in the *ZFAT* gene. A total of 47 rabbits from 24 breeds were genotyped for this *ZFAT* indel. A statistically significant association ($P<0.001$, two tailed Fisher's exact test) was found between the insertion allele and small body size.

The Association of Negative Energy Balance, Sub-Clinical Hypocalcemia, and Periparturient Disease with Rate of Weight Loss and 30-Day Milk Production in Dairy Cattle

SHANNA K. JOHNSON

Under the supervision of Dr. Paula A. Ospina
Department of Animal Science

The objective was to analyze the association of abnormal blood metabolite levels (prepartum and postpartum non-esterified fatty acids (NEFAs), β-hydroxybutyrate (BHB), and calcium) and

periparturient diseases (clinical ketosis, mastitis, displaced abomasum, retained placenta, metritis, lameness and periparturient paresis) with rate of weight loss and milk yield during the first thirty days in milk. A total of 105 Holstein cows from three farms in New York were analyzed. Blood samples, back fat measurements, body condition scores, lameness assessments, and records for body weight, milk yield, and disease occurrence were collected beginning approximately a week before parturition until thirty days in milk. Back fat and body condition scores were not correlated with each other and were not included in the final analysis. The associations between the interaction of each blood metabolite with disease and change in body weight and milk yield were stratified by parity and evaluated with the MIXED procedure in statistical software. All cows that developed disease experienced exacerbated weight loss and reduced milk production than healthy herd mates. Each parity group had a different indicator metabolite for faster weight loss (parity 1 = prepartum NEFA, parity 2 = BHB, parity 3 = postpartum NEFA), but calcium was not a reliable indicator for any group. Elevated prepartum NEFA and BHB levels were associated with reduced milk production for cows of parity > 2, while blood metabolites were only useful for heifers which concurrently developed disease. By using these tests, farmers can intervene early to optimize animal health and economic return.

Modification of Sperm Membrane Lipids to Enhance Cryosurvival

ANDREW M. KELLEHER

Under the supervision of Dr. John E. Parks
Department of Animal Science

The effects of various unilamellar liposomes of various compositions during the cryopreservation of bovine sperm have not previously been effectively explored. Bull semen was diluted to 40 million sperm/mL regardless of treatment and then cooled linearly from 37°C to 4°C. Sperm was then further diluted to a final concentration of 20 million sperm/mL in 7% glycerol. Semen was equilibrated with a 14% glycerol solution and frozen in vapor above liquid nitrogen in 0.5 mL French straws using conventional methods. Sperm motility parameters were evaluated using computer-assisted semen analysis (CASA) prior to cooling, after cooling, and after freezing and thawing. One aspect of this study explored the protection of bovine sperm offered by the incorporation of cholesterol, cyclodextrin (MBCD), and cholesterol-loaded cyclodextrins (CLC) in a 4% soy lecithin extender prior to freezing. Treatments composed of liposomes with 0.05mM MBCD resulted in decreased motility of sperm cells post-thaw when compared to treatments consisting of CLC, but did not differ from treatments consisting of soy lecithin alone. Different concentrations of CLC did not affect motility parameters at any step. These results indicate that CLC was not effective in providing additional protection to sperm during cooling and freezing when combined with soy lecithin. Another aspect explored liposomes composed of soy lecithin alone or in combination with cis unsaturated species of phosphatidylcholine: PC (18:2) or PC (18:3) separately or combined. Initial progressive motility ranged from 57.7 to 66.9% and further decreased to 16.2 to 18.2% post-thaw. A similar pattern was observed for percent total motility.

Enriching Eggs with Omega-3 Polyunsaturated Fatty Acids by Novel Dietary Manipulations

ANDREW D. MAGNUSON

Under the supervision of Dr. Xingen Lei
Department of Animal Science

Currently in the typical North American diet there is a need to increase the amount of omega-3 fatty acids as they are known to have several health benefits against diseases which are becoming more prevalent such as cancer and cardiovascular disease. In this study three experiments were conducted to determine if feeding layer hens sources of omega-3 fatty acids including algae and flaxseed oil would lead to an increase of omega-3 fatty acids in their egg yolks. The first consisted of 30 laying hens which were allotted to 2 dietary treatments comprising a control diet, which replicated commercial diets, and an experimental diet, which was enriched with 12% algae and 5% flaxseed oil, for a 4 week laying period. The second trial consisted of 90 laying hens which were fed 9 diets in total based on a full factorial expansion of both flaxseed oil ranging from 0% to 5% of the total diet, and algae ranging from 0% to 10% of the total diet for a 4 week laying period. The third trial consisted of 50 laying hens that were fed 5 diets including an industry standard as control and 4 diets containing different types of algae for a 4 week laying period**.** From the 3 trials it was determined that hens with algae supplementation in their diets had significant omega-3 fatty acids enrichment in their egg yolks. Egg production, body weight, and feed intake were not impacted by the algae except for high inclusion levels greater than 10% of the total diet.

Carbon and Nitrogen Pools and Yields of Cover and Double Crops in New York State

SHONA B. ORT

Under the supervision of Dr. Quirine M. Ketterings
Department of Animal Science

Including cover or double crops into corn (*Zea mays* L.) rotations can reduce nitrate leaching, soil erosion, and enhance soil health. However, little is known about fall and spring carbon (C) and nitrogen (N) accumulation and the feed value of the cover/double crops grown in New York (NY). Research projects were conducted to (1) determine the fall and spring biomass, C and N accumulation for various cover and double crops; (2) determine the forage quantity and quality of double crops, and (3) compare forage quality of double crops and impact on following corn crop. The statewide survey of 60 fields showed fall N accumulation of N ranged from 18 to 29 lb N/acre for seedings after corn silage harvest, but could reach up to 81 lbs N/acre for earlier seedings after small grains. Planting dates of cover/double crops greatly impacted fall N accumulation. Overwintering cereals terminated as cover crop typically accumulated 37- 45 lbs N/acre in the spring. Total biomass accumulation by double crops ranged from 2.32 to 4.17 tons DM/acre with a total N uptake of 81-157 lbs N/acre. Forage yields were 2.29-2.40 tons DM/acre and quality was good. The replicated trial showed average forage yields of 2.0-2.6 tons DM/acre without and with

106 lbs N/acre applied at greenup, and forage quality was high. We conclude there is great potential for double crops to increase season productivity, but additional research is needed to determine optimum N rate for double crops and to evaluate their impact on following corn crops.

The Impact of Myostatin Genetic Polymorphism on Muscle Conformation in the Horse

NICOLE E. SANGIACOMO

Under the supervision of Dr. Samantha A. Brooks
Department of Animal Science

In this study, we tested the recent hypothesis that a previously discovered polymorphism in the myostatin *(MSTN)* gene could contribute to muscle mass in the Thoroughbred racehorse. The relationship between skeletal and muscle measurements was quantified and compared to the genotypic analysis of myostatin in the horse. A sample of 101 Thoroughbred racehorses, from a variety of locations, was assessed using a previously published set of 35 body measurements. An additional 8 Thoroughbred horses were examined using a recently developed set of muscle measures in order to better quantify the muscle mass of the animals. In addition, photographs were taken of each individual horse (n=109), in order to assess the muscle conformation. Hair samples were also collected for determination of *MSTN* genotype. Photographs and *MSTN* genotype were then assessed and compared, prior to statistical analysis, in order to determine the existence and correlation between muscle conformation and the *MSTN* genotype. Skewed measures and failed genotypic analyses were eliminated from statistical analysis, resulting in a total of 86 individuals. This study demonstrated that there is no direct correlation among conformation, body measurements, muscle measurements and *MSTN* genotype. Horses with a polymorphism in *MSTN* do not exhibit phenotypic differences of the magnitude seen in *MSTN* alleles of cattle and dogs. Subtle changes may be detected in future work with an expanded set of measures, larger population of horses, or by controlling environmental effects due to diet and exercise.

Characterization and Quantitative Analysis of Chytridiomycosis in Eastern Hellbender Salamanders

ALYSSA M. WETTERAU

Under the supervision of Dr. Elizabeth M. Bunting
Animal Health Diagnostic Center

The emerging fungal disease Chytridiomycosis represents the largest global disease threat to biodiversity, exclusively impacting amphibian populations. The causative agent of Chytridiomycosis, *Batrachochytrium dendrobatidis*, has been linked to amphibian population declines in Central America, Europe and Australia. The fungus is found on all six continents where amphibians are located, but despite this ubiquity remains enigmatic in its impact on amphibian populations in North America. The giant North American Eastern Hellbender salamander

(*Cryptobranchus alleganiensis alleganiensis*) has been experiencing population declines for which Chytridiomycosis is widely believed to be a contributing factor. In order to characterize the *B. dendrobatidis* infections found in Eastern hellbenders within tributaries of the Susquehanna River in North Central Pennsylvania, we performed quantitative Polymerase Chain Reaction (qPCR) on collected cutaneous swab samples. In addition, samples of the internal transcribed spacer (ITS) gene of identified *B. dendrobatidis* DNA were sequenced. No difference was found in quantified infection burden across sex and age classes, supporting characterization of the pathogen as a generalist. Low incidence of juvenile captures did not permit a full analysis of the relationship of *B. dendrobatidis* infection and age. Genetic analysis suggested the presence of one predominant strain in conjunction with 28 less frequently observed haplotypes. Phylogenetic analysis of haplotype frequencies and strain differences indicates that one watershed primarily contains a lineage of *B. dendrobatidis* that was later introduced to a different watershed with an extant *B. dendrobatidis* population. Examination of archived samples to examine changing pathogen characteristics could clarify the evolutionary history of Pennsylvanian *B. dendrobatidis*.

The Role of the *kdr-his* Mutation of *Vssc* in Pyrethroid Resistance in House Flies

LAUREN C. ABEREGG

Under the supervision of Dr. Jeffrey G. Scott
Department of Entomology

A major mechanism of resistance to pyrethroid insecticides in the house fly is target site insensitivity due to mutations in the voltage sensitive sodium channel gene (*Vssc*). In the house fly there are three *Vssc* alleles that confer resistance to pyrethroids; *kdr* (L1014F), *super-kdr* (M918T+L1014F), and *kdr-his* (L1014H). A strain homozygous for the *kdr-his* mutation in the background of a susceptible house fly (aabys) was isolated through a series of crosses, selection with permethrin, and single pair crosses. This strain, NChis, was used to determine the level of resistance conferred by the *kdr-his* mutation to five pyrethroid insecticides: cyfluthrin, cypermethrin, deltamethrin, permethrin, and resmethrin. The NChis strain showed resistance ratios ranging from 4.8 (deltamethrin) to 7.8 (cypermethrin). In general, the *kdr-his* allele conferred less resistance than *kdr* and *super-kdr*. In some regions of the eastern United States and Turkey, the *kdr-his* allele has been found at a higher frequency than the *kdr* allele. Additionally, the *super-kdr* allele which was first found in New York in 2003 has remained at a low frequency in New York even though it confers much greater resistance than the *kdr* allele. The high frequency of the *kdr-his* allele and the low frequency of the *super-kdr* allele in Turkey, China, and some parts of the Eastern United States are due to reasons other than the level of resistance that the two alleles offer. Possible explanations for this, including temperature, duration of insecticide use, and concentration of insecticides, are discussed.

Natural Epigenetic Variation of *Sadhu1-1* and *Sadhu6-1* and the Phenotypic Effect of *Sadhu1-1* in *A. thaliana*

ILA S. ANAND

Under the supervision of Dr. Eric J. Richards
Department of Molecular Biology and Genetics

Cytosine methylation is an epigenetic mechanism that has evolved in eukaryotic cells to silence the expression and mobility of transposable elements. Researchers are beginning to use wild plant populations to survey and assess the variation of cytosine methylation polymorphisms among natural strain populations. In *Arabidopsis thaliana*, the *Sadhu* retroposon family exhibits natural variation under the control of epigenetic variation. For instance, in wild type strain Columbia (Col), *Sadhu1-1* is expressed and is not methylated (hypomethylated). However, in another strain Landsberg erecta (Ler), *Sadhu1-1* is methylated and silenced. One possible cause of this variation is sequence polymorphisms between different strains. Methylation analysis of element *Sadhu1-1* and *Sadhu6-1* in natural strains has been correlated with the sequence of the element to understand if sequence polymorphisms are the cause of epigenetic variation. The two elements were studied due to their location on different chromosomes and their different chromatic states. To understand if sequence polymorphisms are correlated with DNA methylation at *Sadhu1-1* and *Sadhu6-1,* 15 strains were

used to generate haplotype networks, respectively. Retroposon sequence data for each strain was collected from the Salk *Arabidopsis thaliana* 1001 Genomes and McrBC assay was performed on each strain to discern the methylation status. Furthermore, the phenotypic consequence of *Sadhu1-1* is unknown. An insertional mutant analysis and statistical analysis were performed to discern the phenotypic significance of the *Sadhu1-1* element.

Sex Ratio in Relation to Hatch Order in a Population of Ospreys (*Pandion haliaetus*)

CALEB M. ARELLANO

Under the supervision of Dr. Irby Lovette
Laboratory of Ornithology

Although many birds have population sex ratios at parity, brood sex ratios often vary 1 considerably among individuals and seasons, suggesting that reproductive females of some 2 species adaptively modify the sex ratios of their clutches of eggs. Hatching asynchrony and 3 sexual size dimorphism can potentially influence brood sex ratios because they influence the 4 costs and benefits of raising offspring of a particular sex. In Ospreys (*Pandion haliaetus*) and 5 other raptors, breeding females might be expected to bias their brood sex ratios towards males 6 (especially in last-laid eggs, which have higher mortality rates), as males are the smaller and 7 therefore less costly sex to raise. Laying male eggs late in the sequence would also augment the 8 size differences among growing chicks that allow facultative brood reduction in times of low 9 food availability. I tested for a relationship between sex and hatch order of 201 chicks in 46 10 nests from a population of Ospreys nesting in two locations, the East and West branches of the 11 Westport River near Westport, Massachusetts. I found male biases in overall brood sex ratios, 12 early and late hatched chicks, broods in both location sites, and in two of my three study years 13 (2010, 2011). When accounting for within-brood non-independent sex composition, male biases 14 in late hatched chicks, East nesting broods, and in 2010 and 2011 were significant, whereas the 15 sex ratios of early hatched chicks and broods found in the West branch did not deviate from 16 parity. These results suggests that sex ratio biases in Osprey broods are affected by hatch order 17 and the experience of breeding pairs, and that females may be able to bias brood sex-ratios at the 18 time of egg laying.

The Effects of Abiotic Stress on the Spatial and Temporal Patterns of Suberin Biosynthesis in *Arabidopsis thaliana* Roots

WILLIAM J. BARNES

Under the supervision of Dr. Jocelyn Rose
Department of Plant Biology

Suberin is a hydrophobic structural polymer that is found primarily in the endodermal cell walls of plant roots. It consists of cross-linked aromatic molecules, very long chain fatty acids (VLCFAs), and other aliphatic compounds, and has a variety of functions, including regulating water status and metabolite transfer. Many studies have investigated the role of suberin in responses to abiotic and

biotic stress using a range of plant species, with the notable exception of the experimental model *Arabidopsis thaliana*. However, several critical aspects of suberin synthesis remain poorly understood, including the basis of its polymerization. This study describes an analysis of the distribution of suberin in the roots of *A. thaliana* grown under a range of conditions, including those resulting in osmotic and salt stress, as well as abscisic acid (ABA) treatments, using histological, chemical, and genetic approaches. In *A. thaliana*, suberin was found to be differentially distributed in response to abiotic stresses in similar patterns as other species. Additionally, biochemical, genetic, and microscopic evidence was obtained to support the hypothesis that a member of the GDSL lipase-hydrolase gene family encodes a suberin synthase (SUS) using *A. thaliana* mutants with T-DNA insertions in the candidate genes. Although no SUS gene was conclusively determined, genetic evidence indicates that two potential SUS genes have been identified, with future experiments necessary to test these candidates. This study therefore details the previously unreported spatial and temporal patterns of suberin synthesis in *A. thaliana* roots in response to stress and hormone treatments, and provides insights into the mechanistic basis of suberin polymerization.

Effects of Invasive European Fire Ants (*Myrmica rubra*) on Herring Gull (*Larus argentatus*) Reproduction

LUKE E. DEFISHER

Under the supervision of Dr. David N. Bonter
Laboratory of Ornithology

Various invasive ant species have negatively affected reproductive success in birds by disrupting nest site selection, incubation patterns and food supply, and by direct predation on nestlings. Impacts can be particularly severe when non-native ants colonize seabird nesting islands where thousands of birds may nest in high densities on the ground or in burrows or crevices. Here I report the first documented effects of *Myrmica rubra*, the European fire ant, on the reproduction of birds in its non-native range. At nests infested by the ants, Herring Gulls (*Larus argentatus*) on Appledore Island, Maine, engaged in more erratic incubation behaviors. Newly-hatched chicks in some nests were swarmed by ants, leading to rapid chick death. Due to high overall rates of chick mortality, survival probabilities did not differ between nests with and without ant activity; however chick growth rates were slower at nests with ants than at ant-free nests. Other studies have suggested that slower growth rates early in life may lead to lower post-fledging survival, therefore ant infestation may lead to longer-term fitness consequences.

Influence of Plant Reproductive Strategy on Herbivore-pollinator Interactions in the Wild Tomato, *Solanum habrochaites*

AMY K. ERICKSEN

Under the supervision of Dr. Andre Kessler
Department of Ecology and Evolutionary Biology

Induced responses to herbivory are beneficial to plants since herbivory often decreases with the production of defense-related chemistry. However, induced responses can carry ecological costs such as pollinator deterrence and fitness consequences of herbivory-induced pollinator limitation should be particularly strong for plants that rely heavily on pollinators, such as predominantly outcrossing species, and less important for species capable of increasing selfing rates following damage. I tested the hypothesis that outcrossing and inbreeding plant mating strategies influence the consequences of herbivore-pollinator interactions using a wild tomato species, *Solanum habrochaites* (Solanaceae), which varies in its ability to self-fertilize. In a 2×2×3 factorial design, I exposed plants from inbreeding and outcrossing populations of *S. habrochaites* to damage (by *Manduca sexta* caterpillars), and created hand pollination (pollen saturation), open pollination, and bagged pollination (selfing) and open pollination treatments to test for the effects of herbivory on pollinator-mediated fitness. Outcrossing accessions were more negatively impacted by herbivore damage in percent fruit and seed set than inbreeding accessions. Additionally, inbreeding accessions showed a higher percent fruit set and seeds per fruit under most treatments. Reproductive assurance occurs in inbreeding accessions of *S. habrochaites* when plants are damaged by herbivores and cut off from pollinators (bagged pollination) and outcrossing accessions have a more plastic response to herbivory through reductions in seed and percent fruit set.

Auxin and Cytokinin Effects on Elongation and Lateral Root Formation of *P. sativum* Excised Roots in Culture

XIAOYUN GONG

Under the supervision of Dr. Thomas M. Silva
Department of Plant Biology

Cultured excised pea (*Pisum sativum L.*) roots do not consistently produce lateral roots in culture. We investigated the effects of auxin and cytokinin separately and in combination on cultured excised pea roots. In the absence of hormones, intact root tips of pea formed a few primordia but didn't consistently branch, while decapitation triggered emergence of a few lateral roots. In comparison, excised soybean (*G. max*) roots consistently produced more primordia and lateral roots than peas. Auxin significantly promoted primordia formation but strongly inhibited emergence of lateral roots and elongation of pea root tips. Deterioration of root tips was also observed under the effect of auxin. Cytokinin alone had a slight inhibitory effect on root primordia formation of intact or decapitated root tips, but no obvious effect on lateral root emergence. Interestingly, slight elongation was observed on some decapitated root tips when cytokinin was added. When auxin and cytokinin were added simultaneously, intact and decapitated root tips of peas responded similarly to those in auxin treatment, which indicated that the effect of auxin might supersede that of cytokinin at a concentration of 1μM. While removing the root apical meristem (RAM) triggered branching, none of the hormonal treatments successfully induced branching of excised pea root tips. Possible explanations and ideas for further study of excised pea root branching are discussed.

Evaluating Minimal Repertoires of *Pseudomonas syringae* pv. *tomato* DC3000 type III Effectors and Their Impact on Host Plant Specificity

TYLER C. HELMANN

Under the supervision of Dr. Alan R. Collmer
Department of Plant Pathology and Plant-Microbe Biology

Many Gram-negative bacterial pathogens utilize a type III secretion system (T3SS) to inject effector proteins into the host cytoplasm to suppress host defenses and promote disease. The model tomato and *Arabidopsis* pathogen *Pseudomonas syringae* pv. *tomato* DC3000 (DC3000) has a fully sequenced and annotated genome, in addition to a well-defined repertoire of effector proteins. Host specificity among *P. syringae* pathovars appears to be linked to variation in effector repertoires. To study this phenomenon, a functionally effectorless polymutant (DC3000 D28E) was previously created, however a residual ability of D28E to elicit cell death in the model plant *Nicotiana benthamiana* suggested the presence of one or more effector proteins still translocated during infection. The T3SS "helper" protein HopP1 and "weak" effector HopAD1 were hypothesized to be the source of residual recognition of D28E *in planta*. DC3000 derivatives such as D28E were no different from a Δ*hopP1* mutant in symptom development under a number of inoculum conditions. Additionally, *Agrobacterium*-mediated expression of HopP1 in both the cytoplasm and apoplast of *N. benthamiana* failed to elicit cell death typical of the defense-associated hypersensitive response (HR). HopAD1 is more of an enigma. In contrast to D28E, a D28EΔ*hopAD1* mutant fails to elicit an HR response in *N. benthamiana*. Yet this same mutant is very similar to D28E when inoculated in tomato. This leads to the new hypothesis that perhaps *hopAD1* is an additional, though weak, avirulence determinant of DC3000 in *N. benthamiana* but not in tomato.

Body Size Correlates with Phylogeny Among Horse Breeds

JULIAN R. HOMBURGER

Under the supervision of Dr. Nathan B. Sutter
Department of Clinical Sciences

The domestic horse (*Equus caballus*) has made many important contributions to human society throughout history. Recently, a SNP microarray was developed that allows high throughput genotyping of over 50,000 horse genotypes. Using 96 horses genotyped on this microarray, our laboratory previously found a correlation between body size and phylogenetic relationships in horse breeds. To extend these initial findings, here we combine our data set with a public data set of 372 horses genotyped on the same microarray. We used principal components analysis and the clustering program Structure to study the relationships between a diverse set of 29 horse breeds. The first major split in the phylogeny separates Thoroughbreds and related breeds from other horses. This is probably due to a combination of three factors: inbreeding within the Thoroughbred population, Thoroughbred sires being used as breeding stock in related breeds, and ascertainment bias on the microarray directed towards Thoroughbreds. The second major split separates large draft horses

from smaller horses, with medium sized horses falling in the middle. We find further splits in the data that correspond loosely to geographic groupings and other commonly known relationships. The major split between large and small horses suggests that gene flow between breeds of different sizes is much less than the gene flow between breeds of similar sizes. Also, size seems to have been an important selected trait before modern breed formation.

Constant Light Alters Behavioral Parameters in Larval Zebrafish *(Danio rerio)*

SHARMILA JAI KUMAR

Under the supervision of Dr. Joseph R. Fetcho
Department of Neurobiology and Behavior

Sleep is a phenomenon that is essential for many organisms in order to grow and function. Zebra-fish are useful models for studying sleep because they possess well characterized genetics, exhibit diurnal activity, circadian rhythms, and have been shown to exhibit sleep-like states through imaging and behavioral studies. The role of light in influencing sleep is of interest because it can be used to understand what factors induce or deprive an animal of sleep, and how this affects the development of the organism. Larval zebra-fish aged 6, 7, and 8 days were tracked for mean velocity in a constant light condition and assessed for health using the parameters of survival, feeding, pigmentation, and position in water column. The results indicate that fish in constant light display similar mean velocities to control animals during the dark period of their cycle, indicating that constant light may actually cause a sleep-like state as an energy conservation mechanism. Constant light fish display no change in feeding behavior, but more fish die after a three day period than in constant light. Also, the constant light causes more fish to drift to the top of the water column and lose motor control, while also causing melatonin secretion to decrease, causing constant light fish to be lighter in pigmentation than control fish. These findings suggest that constant light does alter the behavioral parameters of the fish in age group where the circadian rhythm has already been established.

Development of a Subtractive Hybridization Method to Enrich Viral RNA for Improved Sensitivity of Downstream Diagnostics

THOMAS I. KARTIKA

Under the supervision of Dr. Keith L. Perry
Department of Plant Pathology and Plant-Microbe Biology

Sensitivity is one of the intrinsic limitations of diagnostic assays. For plants such as grapevine, viral titer is often very low and the plant host RNA interferes with assays designed to detect viral RNA. This study describes a method for removing from plant nucleic acid preparations the nuclear-encoded ribosomal RNA (rRNA) – the major constituent of plant RNA. The designed protocol uses biotin-labeled oligonucleotides which hybridize specifically to plant 25S and 18S rRNA. The rRNA-oligo hybrids are subsequently bound to streptavidin-coated magnetic beads and separated from unhybridized RNA by magnetic capture. Results show that with the proper ratio of oligos to

magnetic beads, a near total depletion of the 25S and 18S rRNA may be achieved in a single reaction. Capture was specific and the remaining RNA appeared to retain non-ribosomal RNA, including viral RNA. Subtractive hybridization as applied in this study offers a simple, relatively inexpensive, and quick (<1.5 hours) way to enrich for viral RNA and thus potentially improve the sensitivity of downstream detection assays.

Patterns and Molecular Mechanisms of Resistance to Rifaximin in *Escherichia coli* Associated with Inflammatory Bowel Disease

VISHESH R. KOTHARY

Under the supervision of Dr. Kenneth W. Simpson
Department of Clinical Sciences

Escherichia coli is implicated in the pathogenesis of inflammatory bowel disease (IBD). Rifaximin, a non-absorbable derivative of rifampicin with efficacy against *E. coli,* improves symptoms in mild to moderate IBD. However, rifaximin resistance can develop in a single step *in vitro*. We examined the prevalence and mechanisms of rifaximin resistance in 62 strains of *E. coli* isolated from the ileal mucosa of 51 patients (20 with ileal Crohn's disease [L1+L3], 6 with colonic Crohn's disease [L2], 13 with ulcerative colitis [UC], 4 with non IBD diagnoses [NI], and 8 healthy [H]).

Resistance (MIC >1024 mg/L) was present in 12/48 IBD associated ileal *E.coli* strains (6/25 L1+L3, 1/9 L2, 4/14 UC) vs. 0/4 NI and 0/10 H strains. Resistance correlated with prior rifaximin treatment (P = 0.00002), but not with the presence of ileal inflammation (p=0.73) or *E. coli* phylogroup. Mutations in a 1,057 bp region of *rpoB*, which encodes the bacterial target of rifaximin, were identified in 10/12 resistant strains vs. 0/50 sensitive strains (P<0.0001), and consisted of seven different amino acid substitutions. The efflux pump inhibitor Phe Arg β naphthylamide (PAβN) lowered the MIC of 9/12 resistant strains 8 to 128 fold. Resistance was stable in the absence of rifaximin in 10/12 resistant strains after 30 passages.

We conclude that IBD associated ileal *E. coli* frequently manifest resistance to rifaximin that correlates with prior rifaximin use, amino acid substitutions in *rpoB*, and activity of PAβN inhibitible efflux pumps, but not with the presence of ileal inflammation or *E. coli* phylogroup. These findings have significant implications for treatment trials targeting IBD associated *E. coli*.

Batrachochytrium dendrobatidis Infection Dynamics Vary Seasonally in Upstate New York

MELISSA A. LENKER

Under the supervision of Dr. Kelly Zamudio
Department of Ecology and Evolutionary Biology

The amphibian disease chytridiomycosis, caused by the fungus *Batrachochytrium dendrobatidis* (*Bd*), is a major cause of worldwide amphibian declines and extinctions. Although several studies indicate that *Bd* prevalence and infection intensity vary seasonally, temporal variation of *Bd* at high latitude sites, such as the northeastern United States, is still poorly characterized. We screened amphibians for *Bd* monthly at two study sites in New York State from April to October 2011, and used quantitative polymerase chain reaction (qPCR) to detect and quantify temporal variability in *Bd* infection prevalence and intensity. Our surveys included individuals from thirteen frog and salamander species native to New York State. We found pronounced seasonal variation in both *Bd* prevalence and infection intensity at the community level, and our data indicate that this pattern is due to a few species that drive temporal variability in disease dynamics. Among the three most abundant species, *Lithobates catesbeianus* and *L. clamitans* showed significant seasonal variation in infection intensity, but *Notophthalmus viridescens* did not. *Bd* prevalence and infection intensity increased during the fall and spring and decreased in the summer. Species identity, body temperature, and environmental temperature played significant roles in seasonal changes of *Bd* infection prevalence and intensity. Amphibian body mass and gender were not significant predictors of disease dynamics. Understanding the temporal dynamics of *Bd* host-pathogen interactions may provide critical insight into regional, seasonal, and host-specific determinants of disease outbreaks. Further, our study elucidates the most relevant and informative timing for *Bd* surveys in temperate amphibian assemblages, providing an important framework for future studies of *Bd* impacts on natural populations in highly seasonal regions.

Changes in Acoustic Behavior of Sperm Whales in the Gulf of Mexico following the Deepwater Horizon Oil Spill

ELIZABETH M. MCDONALD

Under the supervision of Dr. Aaron N. Rice
Laboratory of Ornithology

Sperm whales (*Physeter macrocephalus*) are one of the top predators in the Gulf of Mexico ecosystem, and the health of their population is critical to the entire Gulf of Mexico community. This species is extremely amenable to passive acoustic monitoring, as their vocalizations are well-studied, highly distinguishable, produced regularly, and can be detected at relatively long ranges. We used passive acoustic monitoring techniques to record sperm whale calls in the Northern Gulf of Mexico, and measure changes in the time budgets of foraging and social behavior of sperm whales in order to understand the potential impact of the BP Deepwater Horizon oil spill in 2010. Marine acoustic recording units were deployed in three locations in the Northern Gulf of Mexico to record sperm whale vocalizations in July of 2010 and 2011. Sperm whale vocalizations were identified to establish hourly presence in the area. Vocalizations were classified as either social or foraging behavior, and we constructed time budgets of social and foraging behavior based on the hourly occurrence of these calls. We found 39% higher vocal presence of sperm whales in 2011 than in 2010, as well as a 100% increase in the proportion of social calls. This difference in relative time budget indicates that sperm whales had a higher foraging budget in 2010 than in 2011, which suggests that sperm whales spent more time foraging in the period immediately following the oil spill than in the following year. This change in behavior could be due to decreased prey availability in the wake of the Deepwater Horizon oil spill.

Mesenchymal Stem Cells Require Inflammatory Priming to Synthesize Soluble Factors Capable of Reducing the Expression of Interleukin-1β and Tumor Necrosis Factor- α in Equine Chondrocytes and Synoviocytes during LPS-Induced Inflammation

MAX O. MENEVEAU

Under the supervision of Dr. Alan J. Nixon
Department of Clinical Sciences

Osteoarthritis (OA) is a painful and debilitating disease that affects nearly 27 million people in the United States and accounts for nearly $185.5 billion in annual healthcare spending. OA is seen in animals such as horses as well. Recently, the use of stem cell based therapy for OA and joint disease has gained proponents. Though the use of stem cells in treating equine as well as human inflammatory diseases shows much promise, the mechanisms by which these cells modulate the immune response—and thus reduce the effects of joint disease—remain poorly understood. The goal of this study, therefore, was to examine and characterize the effects of soluble factors expressed by MSC's on the expression of the pro-inflammatory cytokines IL-1β and TNFα in equine synoviocytes and chondrocytes. Synoviocytes showed significant downregulation of both IL-1β and TNFα after exposure to media transferred from inflammation-induced (LPS exposed) MSC's, and chondrocytes showed significant downregulation of IL-1β as well. Media from non-LPS exposed MSC's did *not* cause a statistically significant decrease in the expression of IL-1β in chondrocytes, but *did* result in a small but statistically significant decrease in synoviocytes. TNFα expression in synoviocytes was also *not* significantly downregulated by media from non-LPS exposed MSC's. The significant downregulation of both cytokines by "inflammation-primed" MSC's suggests that MSC's respond to inflammatory cues by producing anti-inflammatory soluble factors which are subsequently released into their surroundings. These results provide more evidence for the therapeutic potential of MSC's in treating inflammatory diseases and injury in the horse.

Unmasking Species Richness: Cryptic and Undescribed Snapping Shrimp Species in the Coral Triangle

VICTORIA M. MORGAN

Under the supervision of Dr. James Morin
Department of Ecology and Evolutionary Biology

A significant portion of marine biodiversity is masked by cryptic species. In the Coral Triangle, which is the most diverse marine region in the world, many species remain undescribed and this number is dramatically higher when cryptic species are taken into account. Using both molecular and morphological approaches, this study found 47 "species" or evolutionary significant units [ESUs] in 23 clades, or morphospecies, in the caridean shrimp genus *Alpheus* in the Coral Triangle from just one

microhabitat (dead coral heads). Individual morphospecies contained from one to 13 ESUs. This difference suggests that over half of the apparent diversity remains masked as one or more cryptic species within individual morphospecies. Furthermore, the data also show almost a third of the morphospecies themselves have not been described.

The Effects of Water Mixing on the Zooplankton Community in an Estuarine River

GABRIEL NG

Under the supervision of Dr. Alex S. Flecker
Department of Ecology and Evolutionary Biology

The mixing of water can play a substantial role in zooplankton population dynamics. Water movement can alter environmental parameters that influence zooplankton growth and it can also transport zooplankton into and out of a system. This study examined the impacts of water mixing on the zooplankton community in the Little Choptank River within the Chesapeake Bay. Additionally, we examined whether water mixing varies in different creeks based on their orientation. By using thermistors and weather stations, a mixing coefficient was derived through the discrepancy between measured heat change and calculated heat change. Zooplankton tows were conducted to sample the zooplankton community, and water samples were analyzed for a suite of environmental parameters including temperature, salinity, nutrients, chlorophyll, and total solids. Results indicated that different creeks within the Little Choptank River had similar levels of mixing despite different orientations. Zooplankton assemblages were dominated by two taxa, Acartia tonsa, and cirripede barnacle nauplii, and densities varied both spatially and temporally. However, contrary to expectations, zooplankton densities were not correlated with water mixing. A multivariate linear regression indicated that total suspended solids represented the only measured environmental parameter significantly correlated with zooplankton densities, although this relationship was driven by a few outliers. Calculations of the turnover rates within the creeks could explain the general lack of correlations between environmental parameters and the zooplankton community. These results indicated that transport of zooplankton can play a substantial role in population dynamics within the Little Choptank River by moving zooplankton out of the system before a biological response from the environment could be detected.

Characterizing Microbial β-glucuronidase Activity in Human Gut Microbiota

LAUREN A. RICE

Under the supervision of Dr. Anthony G. Hay
Department of Microbiology

Gut microbes are known to be important in human health and disease, with shifts in their composition being correlated with diabetes, obesity, and metabolic syndrome. Enzymes produced by these microbes may also affect their human host by interacting with food or other compounds in the intestines and releasing potentially harmful metabolic by-products. The aim of this study was to investigate the enzyme β-glucuronidase and the ways in which its activity varies in human gut microbiota. Particularly,

we were interested in looking for correlations between β-glucuronidase activity and microbial community composition and obesity, as well as variations in substrate specificities. This was done using spectrophotometry to measure the kinetic activity of β-glucuronidase in approximately 400 human fecal samples. We also ran these assays with three different substrates in order to study variations in β-glucuronidase substrate specificity. When enzyme rates were compared with the 16S rRNA gene abundances from the fecal samples, it was found that Catabacteriaceae were more abundant in samples with low enzyme activity, while Rosburia and Lachnospira were more abundant in samples with high enzyme activity. No correlation was seen when compared with average Body Mass Index, however other measures of obesity should be tested before ruling out a correlation with obesity altogether. This study has also shown that β-glucuronidase activity varies dramatically depending on the substrate used, which is most likely due to structural differences in these substrates.

Blood Flow Changes Following Posterior Spinal Vein Occlusion in Mice

JONATHAN D. RUBIN

Under the supervision of Dr. Chris B. Schaffer
Department of Biomedical Engineering

Spinal cord blood flow obstructions resulting in ischemia are rare conditions that can result in paralysis if left untreated. Such occlusions also occur following traumatic injury to the spinal cord and play a role in causing secondary injury. Of the few techniques used to study venous infarcts, all have caused secondary trauma to surrounding spinal cord tissue. Using ferric chloride ($FeCl_3$), we have produced an atraumatic injury model to study occlusion of the posterior spinal vein (PSV) in mice. Using two-photon excited fluorescence (2PEF) microscopy, we have quantified blood flow of the PSV and local blood flow dynamics following venous occlusions. The PSV has been shown to branch into large shunts at regular intervals. We have shown that between two adjacent shunts, flow along the PSV depends linearly on distance to a dynamic point at which blood flow bifurcates traveling in opposite directions. Following a single point occlusion, the greatest change in blood flow (more than a 70% decrease) was observed when occlusions were induced near a shunt. Future studies involving venous occlusion or traumatic spinal cord injury models should standardize their injury models to take into account the variation in injury severity we have observed. These findings also have implications clinically, as physicians will need to carefully monitor patients presenting with spinal vein occlusions as clots may dislodge and occlude at positions having greater impact on blood perfusion.

Whole Genome Sequencing and Locus Fine-Mapping Towards Determining the Causal Variants of Horse Body Size Diversity

LINDSAY N. THEODORE

Under the supervision of Dr. Nathan B. Sutter
Department of Clinical Sciences

While the genetics of body size is extremely complicated in naturally reproducing species such as humans, we and others have recently shown that size genetics is highly simplified in domestic mammals. With this in mind, we aimed to identify genetic patterns of size control that may be conserved among domestic mammals through analysis of the horse genome; this analysis began with two equine genome-wide association scans, which revealed four loci related to body size. Here, we expand upon this work by fine-mapping to identify and genotype markers within these loci, towards the eventual identification of causal variants. Two extreme-sized horses (American Miniature and Percheron) were whole-genome sequenced, and these sequences were aligned to discover variants at our loci of interest. These putative variants were then prioritized based on their locations within the genome and their biological likelihood of being related to body size diversity. The highest priority variants were then capillary sequenced and genotyped in a sample set of 4 big and 4 little horses. Each marker's genotype pattern across the sample set was statistically tested for its association with body size, with statistically significant genotype patterns providing support for further investigation of these markers in future projects.

Evaluation of mRNA Targets of the Non-coding RNA Spot42 in Pseudomonas Syringae pv. Tomato DC3000

YUN XU

Under the supervision of Dr. Melanie J. Filiatrault
Department of Plant Pathology and Plant-Microbe Biology

In bacteria, small RNAs can regulate the stability or translation of mRNAs that are involved with bacterial virulence and responses to various environmental stresses. In Pseudomonas syringae pv. tomato DC3000, a sRNA Spot42 was found to play a role in response to hydrogen peroxide and to be regulated by the sigma factor RpoE. In this project, efforts were made to find the mRNA targets of Spot42 in DC3000 by utilizing computational predictions followed by qRT-PCR tests. Several mRNAs were found to be regulated by Spot42. To assess the role of Spot42 in the susceptibility of DC3000 to other oxidative stress, growth curve assays were performed in which the bacteria were exposed to paraquat and ethanol. Δspot42 mutant strain was found not to be susceptible to both compounds.

The Effect of Small Organic Molecule VU_{573} on Transepithelial Fluid Secretion in Malpighian Tubules of *Aedes aegypti*

YASONG YU

Under the supervision of Dr. Klaus W. Beyenbach
Department of Biomedical Sciences

Using high throughput thallium flux assay, a small synthetic organic molecule VU_{573} was shown to inhibit *Ae*K_{ir}1, an inward rectifier potassium channel localized in the basolateral membrane of stellate cells in Malpighian tubules of yellow fever mosquito, *Aedes aegypti.* This study examines

the in-vitro effects of VU_{573} on transepithelial fluid secretion in isolated *Aedes aegypti* Malpighian tubules through the Ramsay assay and electron microprobe analysis, measuring fluid secretion rates and secretion compositions respectively. VU_{573} (50μM) dissolved in 0.05% DMSO was shown to significantly stimulate fluid secretion in Malpighian tubules bathed in both 34mM K^+ ($p<0.01$) and 3.4mM K^+ ($p<0.01$) Ringers. In addition, it significantly decreased the K^+ concentration ($p<0.04$) in secreted fluid without affecting the Na^+ and Cl^- concentration, and significantly increased the secretion rates of Na^+ ($p<0.05$), K^+ ($p<0.04$), and Cl^- ($p<0.02$) in Malpighian tubules bathed in 34mM K Ringer. For tubules bathed in 3.4 mM Ringer, VU_{573} (50μM) significantly increased the Cl^- concentration ($p<0.03$) in secreted fluid without affecting the Na^+ and K^+ concentrations, and significantly increased the Na^+ ($p<0.04$) and Cl^- ($p<0.02$) secretion rates without affecting the K^+ secretion rate. These observations support the projected function of VU_{573} to inhibit *Ae*K_{ir}1 in-vitro, and suggest cells respond differently to such treatment under different environments. VU_{573} (10μM) plus bumetanide (100μM) showed no significant change in fluid secretion rate, indicating increased activity of NKCC cotransporter contributed to the paradoxical stimulation of fluid secretion when treated with VU_{573} alone.

The Effect of CEP-1/p53 Metabolism-dependent Regulation on *C. elegans* Lifespan

JIE YUAN

Under the supervision of Dr. Sylvia Lee
Department of Molecular Biology and Genetics

Many age-related diseases are associated with metabolism and mitochondrial signaling, but often the specific regulatory pathways that govern their interactions are unknown. Recently, the C. elegans transcription factor CEP-1/p53 has been implicated in both the promotion of stress response genes in response to mild ROS stress, resulting in lifespan extension, and the promotion of apoptosis and senescence factors under conditions of severe ROS stress, causing a drastic decrease in lifespan. These two scenarios were represented in this study by the mitochondrial electron transport chain mutants isp-1 and mev-1, which are long-lived and short-lived, respectively, due to elevated ROS production. The role of CEP-1 in mediating these phenotypes was investigated using lifespan assays to establish CEP-1 dependence and microarray experiments to identify subsets of significantly regulated genes. These gene subsets were further analyzed using a variety of bioinformatics tools including hierarchical and k-means clustering, gene ontology (GO) term clustering, de novo searches for transcription factor binding sites, and visualizing protein-protein interactions using interactome networks. Additionally, these data were compared to previous microarray studies on CEP-1 regulation under UV and gamma ray stresses. These analyses revealed highly similar CEP-1 dependent expression pattern changes in isp-1, mev-1, and UV treatments, as well as the possible involvement of C. elegans homologs of the transcription factors SP1 and KLF4 in regulating ROS stress responses. These results will help to provide candidates for further studies to identify specific gene interactions that contribute to CEP-1/p53 control of lifespan as a result of ROS stress.

A Critical Test of the Depressed Metabolic Rate as an Adaptation for Group Living in Social Spiders Hypothesis in Sparassid and Eresid Spiders

MARISSA G. CARDILLO

Under the supervision of Dr. Linda S. Rayor
Department of Entomology

Social carnivores living in webs or in permanent retreats require higher densities of prey to meet their energetic requirements than do their solitary or itinerant relatives. Predator densities are dependent on prey abundance, yet social carnivores that live in permanent retreats tend to live at higher densities than expected. Research by Gilbert, Rayor, and Zimmerman (unpublished) proposed a novel physiological hypothesis that social spiders evolved a depressed metabolic rate to ameliorate the energetic costs of living in groups. To more critically test this hypothesis, we measured O_2 consumption and CO_2 enrichment with a modern Sable Systems stop-flow respirometer. To determine the broad applicability of the depressed metabolism hypothesis for social spiders, SMR was measured in two spider families (Eresidae and Sparassidae), both of which have a number of species with varying levels of sociality. Four species within the Eresidae were measured: the highly social African species *Stegodyphus mimosarum* and *S. dumicola*, the transitional subsocial *S. tentoriicola*, and the Middle Eastern subsocial species *S. lineatus*. Among the endemic Australian huntsman (Sparassidae: Deleninae), we measured one prolonged subsocial species, *Delena cancerides*, and four closely related solitary species, *Beregama aurea, Isopeda (Holconia) nigrigularis, I. (H). hirsuta, and I. villosa*. Evidence of depressed metabolism in social spiders was found in the eresids. In the sparassids, social species had a lower but not statistically significant depressed metabolic rate compared to that of the solitary spiders.

Impacts of Insect Herbivory and Plant Reproductive Strategy on Floral Volatile Chemistry in the Wild Nightshades (Solanaceae)

MICAH G. FREEDMAN

Under the supervision of Dr. André Kessler
Department of Ecology and Evolutionary Biology

Herbivores can induce changes in plant secondary chemistry, including the volatile organic compounds emitted by flowers to attract pollinators. The fitness impacts of these induced changes in floral scent are predicted to vary based on plant reproductive strategy, with more pronounced fitness consequences in self-incompatible species that show a high degree of reliance on pollinators for reproduction. In this study, I used four pairs of congeners in the Solanaceae that differ in their reproductive strategy (i.e. self-compatible versus self-incompatible) to examine the effects of mating system variation on floral volatile production in the presence and absence of herbivory. Self-incompatible species produce floral scents that are both stronger and more diverse than those produced by self-compatible species. Results also demonstrate that herbivores can cause measurable changes in the abundance and number of floral scent compounds emitted by the plant. Together,

these results suggest that interactions between herbivores and pollinators via floral volatile organic compounds may contribute to observed patterns of mating system shifts in the Solanaceae.

What's Sex got to do with it? Effects of Changes in Sexual Size Dimorphism at Maturity on Running Speed in *Delena Cancerides* (Sparassidae)

JACOB A. HURST

Under the supervision of Dr. Linda S. Rayor
Department of Entomology

Sexual Size Dimorphism (SSD) is a consequence of sexual selection that involves differences in body size between males and females of a species. In spiders, SSD can result in huge differences in body size, mass, and leg length between the sexes. Sexual size dimorphism affects many traits within a species, including female fecundity, male competition for mates, and predator avoidance. Throughout the spiders, when male spiders mature, their leg length increases dramatically in contrast to that of females. Because leg length is a sexually dimorphic trait, it is predicted to differentially influence running speed between the sexes. Running speed is a measure of whole-organism performance and reflects the relative fitness of animals. For spiders, increased speed should translate into more success in prey capture, lower relative risk from predators, and decreased rates of sexual cannibalism. Unsurprisingly, the most extreme cases of SSD, found in web-weavers (Nephilidae, Araneidae, Theridiidae), are also those that have been most extensively studied. How increased sexual dimorphism at maturity changes whole-organism performance in less dimorphic families has been understudied. The social huntsman spider *Delena cancerides* (Sparassidae: Deleninae) shows clear sexual size dimorphism which becomes most apparent when subadults in their penultimate instar molt to adulthood. At sexual maturity, males increase leg length with a substantial decrease in mass. To determine how changes in leg length affect running performance, we compared changes in speed, acceleration, body morphometrics, mass, and leg lengths among male and female *D. cancerides* between their penultimate and adult instars. Spiders were filmed running through an acrylic tube using a high-speed camera, and the films analyzed with image tracking software. Our results demonstrate that with sexual maturity, the proportional increase in the length of all leg segments, especially the metatarsus and patella-tibia, was greater in males than in females. This morphological dimorphism translated into differential performance. Increases in absolute speed with maturity were seen in both sexes, but the largest change in speed relative to body size occurred in males. As spider mass increased, running speed decreased. This study demonstrates that SSD has a significant impact on whole organism performance of *Delena cancerides*. Adult males move large distances between retreats in search of receptive females, while adult females are much more sedentary once they have claimed a retreat. Therefore, the SSD observed in *D. cancerides* results in improved performance for the different ecologically relevant tasks each sex performs.

Designing for Successful Salamander Crossings: A Proposal for the Greenbelt Nature Center

KRISTEN E. REARDON

Under the supervision of Dr. Josh F. Cerra
Department of Landscape Architecture

In our increasingly urbanizing world, habitat fragmentation caused by roadway development is becoming more widespread. As a result, many species lack resources within their habitats and must cross dangerous roads, resulting in an increase in species mortality. To prevent further mortality and the decrease of populations, structures can be built to allow animals to safely cross roadways to access their necessary habitats. The spotted salamander, *Ambystoma maculatum*, has experienced a decrease in its population due to roadway impacts that prevent it from safely moving from moist upland habitats to wetland and vernal pools for breeding. By installing culvert underpasses, salamanders can cross roads safely, allowing them to mate and return to their resident habitat.

However, in order for these crossings to be more successful, additional work needs to be done. Much of the public does not understand the effects of urbanization on sensitive wildlife populations. Landscape architects, engineers, ecologists, and planners need to work together to create crossings that highlight these issues. By designing interpretive educational areas in combination with wildlife crossings, wildlife and human visitors can both benefit. With more people understanding the issues involving habitat fragmentation and degradation, opportunities for habitat-sensitive sustainable development increase.

Didymosphenia geminata (Didymo) on Macroinvertebrate Communities in Esopus Creek, New York

EMILY R. BIALOWAS

Under the supervision of Dr. Joseph B. Yavitt
Department of Natural Resources

Didymosphenia geminata (didymo or "rock snot") is a nuisance algae that is expanding its range globally. Though native to the northern hemisphere, didymo has not been seen in such large densities until recently: blooms have been recorded in New York State since 2007 and the Ashokan Reservoir watershed since 2009. Didymo cells and stalks form mats that attach to stream sediments and rocks, effectively changing the habitat substrate for those living in the stream. Larval macroinvertebrates living on rocky riffle zones for growth and feeding might be particularly affected. I tracked the bloom at seven points on Esopus Creek from the headwaters down to the inlet to Ashokan reservoir throughout the summer. I measured the density of didymo in biofilms via chlorophyll a, biofilm biomass, and didymo cell counts. I sampled benthic macroinvertebrate communities using the standard kicknet method of sampling. Results indicated that sites with high levels of didymo are more likely to have impacted water quality scores based on the macroinvertebrates collected. Biodiversity was lower in sites with high didymo density. This indicates that unchecked didymo growth is detrimental to the ecosystems in which it exists, and that management solutions must be found to prevent the deleterious effects of didymo from continuing further.

Secondary Effects of Hemlock Woolly Adelgid (*Adelges tsugae*) Infestation on Hemlock Stands and Implications for their Management in Ithaca, NY

KELSEY K. ERICKSON

Under the supervision of Mark C. Whitmore, Extension Associate
Department of Natural Resources

The Hemlock Woolly Adelgid (HWA, *Adelges tsugae*) is an invasive aphid native to Japan that was introduced to Richmond, Virginia in 1950 and has spread rapidly since then. One of its host trees is the Eastern Hemlock (*Tsuga canadensis*), which it kills by feeding on the sap and causing die-back of the needles. In the Western U.S. a native predatory beetle, *Laricobius nigrinus,* has been an effective biocontrol of HWA, thus preventing large-scale mortality of Hemlock Trees. We released several thousand individuals of L. nigrinus at four sites in Ithaca, NY, where HWA infestations had been observed: the Edwards Preserve, Willow Point, Caywood Point, and Glenora Point. We examined trees at two sites, Caywood Point and the Edwards Preserve, in late October and early November after the beetles awakened from aestival diapause to assess *L. nigrinus* colonization. Although no beetles were found in the tree canopy, there were many Spruce Spider Mites. I recorded the amount of new growth (if any) on 10 twigs, the number of sistens on each twig and subjectively assessed the amount of fluff on the twigs using a five-point scale (1 having no fluff to 5 having a

high amount of fluff). The results showed that the abundance of Spruce Spider Mites was directly correlated with the amount of fluff, suggesting that HWA infestation renders Hemlocks more susceptible to colonization from Spruce Spider Mites.

Quantifying Marcellus Shale Effects on Habitats and Communities

CASSANDRA F. L. GARCIA

Under the supervision of Dr. Stephen J. Morreale
Department of Natural Resources

Hydraulic fracturing for natural gas is increasing in the northeastern United States, resulting in loss of continuous forest and increasing forest fragmentation. The effects of pipeline and well pad openings on forest amphibians and reptiles are not known. We used natural cover and coverboard transects from the well pad and pipeline openings into the adjacent forest to determine these effects. In addition we employed habitat restoration techniques in the middle of pipelines to see if they could help mitigate effects. We expected an increase of herpetofauna with an increase in distance into the forest interior from the pipeline and well pad openings. We found a sharp decrease in air temperature and light within the first 10 meters from an opening to the forest. The number of redback salamanders increased significantly from well pad and pipeline opening edges into the forest interior with a strong effect within the first 15 meters. The increase was associated with more cover from small sticks, large sticks, and small rocks in the forest. Although our initial habitat restoration techniques did not mitigate the effects from the pipeline as we thought that they would, we did discover that the proximity of the mitigation technique in relation to the pipeline to forest edge may be beneficial for salamanders and other herpetofauna.

The Effects of Soil Calcium Restoration on the Growth Rate and Annual Mortality of Sugar Maples in Hubbard Brook Experiment Forest (HBEF)

TIANJUN HOU

Under the supervision of Dr. Timothy J. Fahey
Department of Natural Resources

Atmospheric deposition of strong acids (acid rain) over the past 25 years has contributed to the decline of sugar maple trees in Hubbard Brook Experimental Forest (HBEF), New Hampshire, USA. One reason for the decline is soil calcium (Ca) deficiency. In October 1999, researchers applied wollastonite ($CaSiO_4$) to the soil of watershed 1(W1) in HBEF to restore soil Ca to pre-industrial level. We compared the response of sugar maple in the Ca treated watershed 1 to trees in the control watershed 6 (W6). From 2006 to 2012, the average growth rate in W1 was significantly greater than that in W6. The average mortality in W1 is was significantly less than that in W6, at a statistical confidence interval of 80%. In both watersheds, the average growth rate increased as 1) the crown die back decreased and 2) foliar transparency decreased. For any value of crown die back or foliar transparency, the average growth rate was higher in W1 than that in W6. However, the slope of the

relationship between tree growth rate and die back differed significantly between W1 and W6, whereas the analogous result for transparency was not significant. These results reaffirm that soil Ca deficiency contributes to sugar maple decline. Sugar maples in control sites may allocate more carbon to develop its root system for Ca uptake or to heal wound or for other potential costs. Trees with similar symptom class perform better in Ca treated site, which indicates that the mechanism of Ca for growth rate is more complex than just building healthier canopies for more photosynthesis.

Possibilities for the Emergence of Civic Ecology Practices in Response to Social-Ecological Disturbance: The Case of Nuisance Chironomids in Singapore

MOU JIAN LEE

Under the supervision of Dr. Keith G. Tidball
Department of Natural Resources

My research aims to investigate whether civic ecology practices might emerge in Singaporean communities in response to chironomid disturbance. In recent years, unprecedented mass emergence of chironomids has occurred around two of Singapore's reservoirs, disrupting the lives of surrounding communities. Civic ecology practices would have been a valuable source of resilience toward this disturbance, because the practices would integrate individual, community, and environmental outcomes through grassroots stewardship initiatives. Various possibilities for civic ecology practices exist as resources get released from social-ecological systems by disturbances. However, civic ecology practices seemed to be absent among the communities. I used the tri-method of analyzing news articles, social media content, and government documents as well as observing public behavior to explore social-ecological relationships surrounding the nuisance issue. This allowed me to mine underlying mechanisms that might explain the lack of civic ecology practices, underlying potential of the reservoir social-ecological systems for adapting to the disturbance through civic ecology practices, and barriers to the emergence of those practices. I found that the initial conditions were not present for the emergence of civic ecology practices in those reservoir social-ecological systems, because the chironomid disturbance was not large enough to bring the reservoir social-ecological systems to "tipping point". Nevertheless, the systems' potentials lie in their various biophysical, cultural, and socioeconomic resources. Barriers to the use of these resources exist to block the fulfillment of these potentials however. My research will further understanding on civic ecology and resilience through the unique perspective of a multicultural Asian city-state.

A Comparison of Predation on Soft-Shell Clams (*Mya arenaria*) and Stout Razor Clams (*Tagelus plebeius*)

MARGARET M. LUEBS

Under the supervision of Dr. Joseph B. Yavitt
Department of Natural Resources

In the past forty years, the population of soft-shell clams (*Mya arenaria*) in the Chesapeake Bay has dropped precipitously and remained low. One potential cause of this drop is predation, in particular, by blue crabs (*Callinectes sapidus*) and horseshoe crabs (*Limulus polyphemus*) in the bay and its tributaries. Although research has shown that these crabs eat clams, there is limited information about the clam species they prefer and the rate at which the clams are consumed. I examined the predators' prey preferences and prey-consumption rates both in laboratory studies and in the Rhode River. *M. arenaria* and the highly populous stout razor clam (*Tagelus plebeius*) were used for comparison. Through the use of exclusion cages, it was observed that predators in the Rhode River, a Chesapeake Bay tributary, preferred *M. arenaria* over *T. plebeius*. Mesocosm tanks were used to isolate which predator displayed this preference. Neither blue crabs nor horseshoe crabs displayed a preference between these species; this was likely due to an insufficient depth of sand refuge for *T. plebeius*. Despite this, the crabs did consume clams more slowly when the clams were able to burrow into sand. These results highlight the need for further research to better understand the relationships between crabs and clams and to determine the cause for the *M. arenaria* population decline. In turn, these data will allow policy makers to make more informed decisions about both clam- and crab-fishery management.

The Sound of Danger: Threat Sensitivity to Predator Vocalizations, Alarm Calls, and Novelty in Gulls

SARAH A. MACLEAN

Under the supervision of Dr. Janis Dickinson
Department of Natural Resources

The threat sensitivity hypothesis predicts that organisms will evaluate the relative danger of and respond differentially to varying degrees of predation threat. Doing so allows potential prey to balance the costs and benefits of anti-predator behaviors. I experimentally exposed incubating herring gulls and great black-backed gulls to auditory stimuli representing a range of potential threats in order to compare the relative perceived threat of heterospecific alarm calls, conspecific alarms calls, predator vocalizations, and novel auditory cues. Gulls were able to discriminate among a diverse set of threat indicators and respond in a manner commensurate with the level of threat, as predicted by the threat sensitivity hypothesis. The contact call of a western scrub-jay (novel stimulus) elicited a response intermediate between known threats and a known non-threat in herring gulls, but not great black-backed gulls. Recordings of the human voice (predator vocalization) elicited a stronger reaction than a bald eagle vocalization and both gull alarm calls. Conspecific alarm calls were more threatening than heterospecfic alarm calls to great black-backed gulls, but herring gulls weighted both equally. My results show that birds vary their responses to auditory threat stimuli based on a diverse suite of factors including familiarity, sender reliability, and receiver vulnerability.

Management of Chicago's Lincoln Park Ash Trees in the Face of Emerald Ash Borer: A Spatial Plan Using ArcGIS 10.1

ERICA M. MERRITT

Under the supervision of Dr. Stephen D. DeGloria
Department of Crop and Soil Sciences

Emerald Ash Borer (EAB, *Agrilus planipennis*) is an invasive pest from Asia found in Canada and in the midwest Unites States. The EAB feeds on the phloem of ash trees, leading to tree death. The adult female borer moves to un-infested trees to lay her eggs, and chooses new trees based on certain plant traits such as health, size, and distance from home tree. Preemptive management based on plant traits might be able to reduce damage in yet-to-be infested stands. This study focused on Chicago's lakefront Lincoln Park (LP). The park has not reportedly had any infestation, but due to the high likelihood of its appearance in the coming few years, a management plan is an economically, ecologically, and aesthetically pleasing alternative to a sudden removal of all ash trees after infection. To begin a management plan, this study used an inventory of ash trees in LP. Values were assigned to each tree based on its environment to determine (1) the safety risks posed by the tree should it fall and (2) the likelihood of infection. By creating maps of the park using ArcGIS 10, I was able to determine priority trees in treatment/removal. Further, a sensitivity analysis on the environmental attributes was preformed to ensure sound results of priority trees. I expected soil to play a small role in determining health of the tree and density to play a large role as well as distance to buildings being a determining factor in management strategies.

Place Matters: A Comparative Analysis of Conservation Awareness in New York and Massachusetts

EMMA L. SCHNUR

Under the supervision of Dr. Shorna Broussard Allred
Department of Natural Resources

The Conservation Awareness Index (CAI) is a survey instrument used to assess the preparation of forest owners to make informed decisions about their land. Here we describe the first deployment of the CAI out of its state of origin, Massachusetts, which we administered to 496 randomly selected New York family forest owners and 158 benchmark landowners. Results confirmed instrument validity and exposed low levels of awareness about conservation options among random respondents, especially concerning New York's current-use tax program and conservation easements. Education level, ownership acreage, and location were associated with conservation awareness. A comparative analysis between New York and Massachusetts revealed greater awareness among forest owners in Massachusetts. The CAI can be used to improve outreach efforts by targeting conservation options with which landowners have low levels of awareness. The survey instrument can be utilized on a larger geographic scale to see how levels of conservation awareness vary on a regional or national scale.

Investigating the Environmental Source and Function of Thiaminase I

JENNIFER M. SUN

Under the supervision of Dr. Clifford Kraft and Dr. Esther Angert
Department of Natural Resources / Department of Microbiology

Thiaminase I is a vitamin B1 (thiamine)-degrading enzyme linked to a number of thiamine deficiency diseases in humans, ruminant mammals, commercially important fish, alligators, foxes, and other organisms. Susceptible species obtain thiaminase I by consuming organisms that harbor thiaminase, but the ultimate source and physiological function of the enzyme are unknown. We used both controlled laboratory experiments and the testing of environmental tissue samples to investigate the hypothesis that bacteria are ultimately the source of thiaminase I, Preliminary results show that thiaminase I activity in quagga mussels reared in aquarium tanks was increased or decreased by treating the water with various antibiotics, which supports the hypothesis that bacterial communities in metazoans are linked to thiaminase I activity. Both goldfish raised from eggs in a controlled laboratory setting and blueback herring collected from the Hudson River showed higher levels of thiaminase I activity in later stages of development, suggesting that thiaminase I-producing bacteria accumulate in fish during development, leading to the high thiaminase I levels observed in adult fish. The results provide good evidence that bacteria are linked to thiaminase I production in animals and provide the basis for future efforts to investigate how specific changes in bacterial abundance or diversity can regulate thiaminase I activity in animals.

Nesting Patterns and Reproduction Tradeoff Trends for Leatherback Turtles at Sandy Point (St. Croix, US Virgin Islands)

OLIVIA L. WALTON

Under the supervision of Dr. Joseph B. Yavitt
Department of Natural Resources

Populations of leatherback turtles continue to decline in many locations due to anthropogenic factors such as loss of habitat, fishing activity, and overharvesting of eggs. As a result, leatherbacks are listed as critically endangered, though conservation efforts can reverse the trend, such as at Sandy Point, St. Croix, USVI where a long-term conservation effort has seen great success. I used nesting data collected annually since 1982 to examine growth and reproduction ecology, which might help explain their recovery at this site. Over this 20-year period, the number of leatherback visits to Sandy Point has increased enormously from 133 turtles in 1982 to 1171 turtles in 2001: the number of females increased from 21 in 1982 to 186 in 2001. The peak month for visits was May. Nesting trends in terms of clutch size were relatively constant with the number of eggs laid per visit fluctuating between 73-86 eggs per nest. The typical number of eggs laid over an entire season was 50-150 eggs per turtle. In terms of reproductive effort, I found a negative trend between clutch size and annual growth in centimeters. This tradeoff indicates that larger turtles are growing less and

reproducing more. The results demonstrate that the conservation effort at Sandy Point has led to a strengthening of the local leatherback population, and that continued efforts and local support will only further protect this population.

Iron Deficiency and Physical Activity after a Dietary Iron Intervention in Female Indian Tea Pickers

YOSMEL SERRANO

Under the supervision of Dr. Jere D. Haas
Division of Nutritional Sciences

The objective of this study is to examine the effect of a double- fortified salt (DFS) (containing iron and iodine) intervention on iron status and physical activity in female Indian tea pluckers. A double-blinded study randomized 132 women working at a tea estate in West Bengal, India to consume either iodized salt fortified with iron (DFS) or iodized salt (control) for 10 months. The DFS group received approximately 5-7 mg iron/day. Iron status (Hb, sFt, sTfR), inflammation markers (CRP, AGP), and physical activity levels (estimated through Actigraph accelerometers) were determined at baseline and end line data collection. Physical activity was categorized by the number of minutes spent in sedentary physical activity (1.00 MET), light physical activity (1.01-2.99 METs), and moderate-to-vigorous physical activity (≥3.00 METs) at work and discretionary (before work, after work, and during break) time. There was a significant increase in sFt ($p<.0001$) and body iron ($p<.0001$) from baseline to end line in the DFS group compared to control group. The difference-in-difference analysis showed a statistically significant change ($p<0.05$) in total work time with a -8.4 min. and -29.2 min. change from baseline to endline between the DFS and control group, respectively. We conclude that consumption of DFS improved iron status and was related to a change in physical activity patterns before and after work. *Funded by the Mathile Institute for the Advancement of Human Nutrition and the Macronutrient Initiative.*

Food Prime Effects on Eating Behavior in Preschool Children

HILARY A. SOOHOO

Under the supervision of Dr. David A. Levitsky
Division of Nutritional Sciences

Objective
To determine the effects of food primes and non-food primes on the food consumption and overall intake of preschool children.

Methods
A total of 8 preschool children were recruited to participate in the study at a preschool located on campus that served university faculty. On two separate occasions, the sample of children was exposed to either a food prime or a non-food prime through a series of four pictures of either food related images or non-food related images respectively. Follow-up questions were then asked about the images. A snack consisting of sliced apples and milk was served immediately after the exposure and consumption of the snack and beverage was measured.

Results

Food and milk consumed under a food prime were not significantly different from food and milk consumed under a non-food prime using a one-tailed T-test. However, when gender and the difference in intake under food and non-food prime was associated with non-food prime snack consumption, the difference in consumption was significantly different in food-primed males when exposed to a food prime. The difference in consumption was significantly different from zero when associated with non-food primed consumption for males. Food-primed females consumed less under a food-prime than under a non-food prime however the difference when associated with non-food prime consumption was not significant.

Identification of Microbes Producing Mousy Taint in a Hard Cider

MELISSA M. AELLEN

Under the supervision of Kathleen J. Arnink, Lecturer
Department of Food Science

Mousy taint is a cider and wine fault with the odor of rodent bedding. Organisms were isolated and purified from a cider described as possessing mousy taint. The organisms were then grown in a cider medium and evaluated for the production of a mousy taint odor compound, 2-acetyltetrahydropyridine, by untrained panelists. The three different microorganisms from this cider were identified by DNA sequencing were *Saccharomyces cerevisiae* (5 strains), *Sporobolomyces roseus* (2 strains), and *Bulleromyces albus* (1 strain). According to our panelists, both *S. roseus* strains created mousy taint odors (95% confidence) while 3 strains of the *S. cerevisiae* may have created mousy taint (less than 95% confidence). *B. albus* conclusively did not create mousy taint. This study suggests for the first time that *S. roseus* and *S. cerevisiae* may be able to create mousy taint and should be researched further.

Influence of Ascorbic Acid on the Color of Iron Fortified Chocolate Milk

CEDRIC I. AHN

Under the supervision of Dr. Dennis D. Miller
Department of Food Science

Staple foods are often fortified with minerals and vitamins in order to reduce nutritional deficiencies. Iron is an example of a widely used fortificant in certain foods. Many nutritionists have suggested that chocolate milk would be a suitable vehicle for iron fortification. However, there are many challenges when fortifying chocolate milk with iron due to undesirable sensory changes. The objective of this study was to find a viable iron fortificant that produces sensory properties in chocolate milk comparable to those in the control sample and which maintains a relatively high solubility over time. Four iron compounds were evaluated: ferrous sulfate, encapsulated ferrous sulfate, ferric sodium ethylenediaminetetraacetate (NaFeEDTA), and micronized ferric pyrophosphate. The iron fortificants were added to pasteurized, homogenized, one percent chocolate milk and soluble iron concentrations and color were measured by colorimetric assay and an objective color measurement, respectively over either 14 days and 21 days. Color readings of the control were also measured over 21 days. The color of the fortified milks differed from the control for all treatments at all time periods whether or not ascorbic acid was added ($P < 0.05$). Treatment groups with ascorbic acid added did not different significantly over time, unlike the treatment groups without ascorbic acid ($P > 0.05$).

Verification of Tropical Storm Track Prediction in Southeast Asia Using GFS Model

CHEUK YI JOSEPH LEE

Under the supervision of Mark W. Wysocki, Senior Lecturer
Department of Earth and Atmospheric Sciences

This study investigates the skill of the Global Forecast System (GFS) model in predicting tropical cyclone (TC) tracks and intensity in SE Asia from 2007 to 2011. Data from 27 TCs passing through the grid box from 20° to 25° N and 110° to 120° E are analyzed. The GFS lowest central pressure forecast is used to determine the forecasted locations of the TCs. Forecast tracks and central pressures are compared to the TC best track records produced by the Joint Typhoon Warning Center (JTWC). Average errors and biases in latitude, longitude, absolute distance and central pressure are calculated for all the TCs. The GFS forecast tracks exhibit greater longitudinal errors than latitudinal errors, North and East biases relative to the observation, as well as an underestimation of TC strength. An elliptical forecast cone method is proposed so as to visually account for the directional biases of the GFS model.

Pulsed Light Treatment for the Decontamination of Dairy Products

BRITTANY M. MILLER

Under the supervision of Dr. Carmen I. Moraru
Department of Food Science

Foodborne illness caused by pathogenic bacteria and food spoilage are two major persisting problems in the food industry in general, and the dairy industry in particular. Pulsed light (PL) is an emerging, light-based microbial inactivation treatment. The treatment features quick pulses of broad spectrum light, which inactivate microorganisms by creating DNA damage. While PL has true potential for use in the dairy industry, there is a need for information regarding the efficiency of PL for microbial decontamination of dairy products. To address this need, the main objectives of this study were to: 1) evaluate the effectiveness of PL treatment for the inactivation of non-pathogenic *Escherichia coli* in dairy products and 2) evaluate the effect of dairy product composition on inactivation. The study focused both on volumetric microbial inactivation in fluid systems (fluid milk and concentrated milk) and on the surface of cheese slices, both directly and through transparent polyethylene packaging. For fluid products, the treatment resulted in a maximum inactivation of over 2-log, under turbulent conditions and at low levels of solids and fat. A high level of solids and fat affected the optical properties of the substrate, and hindered the efficiency of the treatment. For the treatment of cheese, inactivation levels of 2 to 3-log were obtained, both in the presence and absence of transparent polyethylene packaging. The results of this study demonstrate that PL could be a practical, quick decontamination step for dairy products.

Synoptic Causes of Changes in the Statistical Distribution of January Daily Maximum Temperatures in the Interior Northeastern U.S.

JEFFREY M. SUSSMAN

Under the supervision of Dr. Arthur T. DeGaetano
Department of Earth and Atmospheric Sciences

The frequency of anomalously warm January daily maximum temperatures in the interior Northeast has increased over the past 60 years. This study focuses on the increase in maximum temperatures in the region, as related to changes in the shape of the statistical distribution of daily maximum temperatures. Possible causes for these changes from a synoptic pattern standpoint are a focal point. The January daily maximum temperature data for this region show an increase in the maximum temperatures, but not a uniform shift in the overall distribution of daily maximum temperatures.

A principal components analysis (PCA) of 500 hPa heights for January days, followed by a cluster analysis is used to determine the most commonly occurring synoptic weather patterns in the United States in January. This allows for analyses of changes in the frequency of occurrence for each pattern, as well as changes in the temperature distribution associated with different patterns. The analysis in this study show a statistically significant change in January synoptic weather patterns and in the temperatures associated with some of these patterns. Some amplified ridge-trough patterns have increased in frequency, while zonal patterns and less amplified ridge-trough patterns have declined in frequency. Within all patterns the average daily maximum temperature has increased by up to 5^{o}C with the largest changes occurring in zonal patterns that are typically associated with the warmer temperatures.

Acquired Resistance to Mefenoxam in Sensitive Isolates of *Phytophthora infestans*

RICHARD A. CHILDERS

Under the supervision of Dr. William E. Fry
Department of Plant Pathology and Plant-Microbe Biology

The systemic fungicide mefenoxam is an important fungicide in the control of late blight disease caused by *Phytophthora infestans*. The susceptibility or resistance of *P. infestans* to mefenoxam is commonly assessed *in vitro* through measuring the mycelial growth of the pathogen in response to increasing concentrations of the fungicide in amended media. However, recent observations suggest that the prior exposure of an isolate in culture to mefenoxam can cause a rapid increase in the observed pathogen resistance in subsequent mefenoxam resistance assays. This change has thus far been observed in several isolates from clonal lineages US23 and US24, with significantly increased resistance evident after a single transfer. This acquired resistance might pose a challenge for accurate determination of in vitro mefenoxam sensitivity, and possibly for control of sensitive isolates in the field, although comprehensive in vivo assays are required before the latter can be determined. A genetic basis for this acquired resistance seems unlikely, given the speed of the change. Thus, single-strand specific RNA-Seq was employed to examine differential expression between stably resistant isolates, isolates that have acquired resistance and "non-exposed" isolates, generating various candidate genes. Additional assays, including RT-PCR/qPCR gene expression confirmation, and possibly gene silencing, may be employed to further investigate the role of these candidate genes in the acquisition of resistance.

Southwestern Pecan Orchard Soil Standards

KATHERINE E. GRANDLE

Under the supervision of Dr. Murray B. McBride
Department of Crop and Soil Sciences

The Rio Grande Basin in southern New Mexico and western Texas has become a large source of commercially produced pecans over the past few decades, yet agronomic research specific to soil management and fertilization in this area has not yet been fully developed. This project aims to review the currently published optimal soil analysis ranges as well as to identify significant relationships between soil characteristics and yield which merit further investigation. Over the 2012 growing period, 106 production blocks in Dona Ana County were observed. Soil analysis was conducted on each block prior to budbreak and after harvest to review soil changes over the full growth cycle; yield and tree counts were also collected. Due to alternate bearing in pecans, yield has been analyzed in four population groupings: "ON" blocks only, "OFF" blocks only, all blocks using a two year yield average, and all blocks using a dummy variable to isolate the alternate bearing yield differences. Mixed regression models were used to identify optimal levels and significant relationships within all four groupings. Of the production blocks observed, the soil analysis results fell within only 22% of the published optimal ranges, which are not crop specific. Boron, Bulk Density, Copper, Iron, Magnesium, Manganese, and Zinc were all identified as exhibiting significant, largely negative, relationships with

yield, suggesting that these variables may be inhibiting production. The observed relationships merit further investigation and optimal soil analysis ranges must be developed in order to ensure correct interpretation of results and subsequent soil management practices.

Virus-Plant Protein Interactions: The Importance of the *Potato leafroll virus* Readthrough Protein

JACLYN E. MAHONEY

Under the supervision of Dr. Michelle L. Cilia
Department of Plant Pathology and Plant-Microbe Biology

Potato leafroll virus' (PLRV's) C-terminal domain of the readthrough protein (RTP) is known to be involved with active retention of the virus in plant phloem. In this investigative study we used a combined proteomics and molecular virology approach to determine the identity and function of those plant proteins that are interacting with the readthrough domain of the RTP. Using a novel, on-plate co-immunoprecipitation method, we compared those plant proteins co-immunoprecipitating with the wild type form of PLRV with those that co-immunoprecipitate with a mutant form of the virus lacking the readthrough domain using *N. benthamiana* as a model system. Controls were thoroughly characterized to identify proteins that were non-specifically interacting with virus. Our research yielded four candidate proteins that appear to interact with the readthrough domain of the RTP and hence, are likely involved with phloem retention. The candidate proteins are as follows: 14-3-3 protein (AT1G78300.1), probable 26S proteasome non-ATPase regulatory subunit 3, membrane steroid-binding protein 2, and elicitor-inducible protein EIG J7. These four proteins were detected in the WT PLRV infected *N. benthamiana* as having 2.5-fold or greater enrichment as judged by spectral counts over a mutant that lacked the readthrough domain (ΔRTP) or control *N. benthamiana* tissue, and were also found in the host potato system with 2.5-fold or greater enrichment in WT PLRV infected potato as compared to healthy potato. These candidate proteins will be the focus of future validation studies to determine the function of these plant proteins in PLRV infection.

Putting a Dent in Our Understanding of Maize Kernel Morphology

MATTHEW D. MURRAY

Under the supervision of Dr. Edward S. Buckler
Department of Plant Breeding and Genetics

Much of our modern maize germplasm was originally brought about by the combination of northern flint lines and southern dent lines. Yet commercial production in the U.S. today is dominated by dent or semi-dent kernel type maize (Corn Belt dent), which has hard outer walls of endosperm surrounding a soft floury interior that when dried compacts to form the characteristic dent in the top of the kernel. One major exception is flint type corn, which is grown in areas of North America, Europe, South America, the Caribbean and many parts of Africa. Flint maize is characterized by its rounded vitreous outer

endosperm and soft granular center and has desirable qualities such as cold tolerance, disease and insect resistance as well as longer storage capacity than many dent lines.

The Nested Association Mapping (NAM) population parent inbred lines represent many of the major kernel types found in maize. In 2006 the entire NAM population of recombinant inbred lines were grown and scored visually for kernel type, in five locations. The NAM population contains 25 parents, of which, there are nine flint, nine semi-dent, four dent, two sweet and one popcorn parent lines, with a common dent parent, B73. Linkage mapping with ~7400 intervals markers was used to examine the genetics of kernel morphology. This yielded several areas of the genome that are significantly associated with the difference in kernel type seen in NAM. Several other major and minor QTL are shared across many families. Genome wide association study (GWAS) was also used in the maize association panel. Suggested peaks from both linkage mapping and GWAS highlight 13 candidate genes in starch and protein related pathways in the endosperm.

Differences in Plant Available Nitrogen between Two Organic Management Regimes

ELIZABETH A. PERKUS

Under the supervision of Dr. Laurie E. Drinkwater
Department of Horticulture

The goal of this research was to test two contrasting organic vegetable management regimes for differences in available nitrogen and microbial parameters controlling nitrogen availability. The two systems studied are “High Compost System,” a crop intensive, compost fertilized vegetable system, and “Low Compost System,” a less crop intensive, primarily cover-crop fertilized vegetable system. Soil samples were collected from both systems and oats (*Avena sativa*) grown on them under controlled growth chamber conditions. Oats are a uniformly fast-growing grass with a fibrous root system that results in a large amount of rhizosphere, where most soil microorganisms are found. Measurements of plant biomass, plant nutrient status, soil nitrogen, soil carbon, microbial biomass, soil exoenzyme activity, extractable soil nitrogen and potentially mineralizable soil nitrogen were taken to assess plant growth, nitrogen availability, and microbial activity. Oats grew to an average biomass of 15.27 g in the High Compost System and 6.00 g in the Low Compost System. The High Compost System had more total soil nitrogen and twice the amount of initial extractable nitrate when compared with the Low Compost System. This research suggests that higher nitrogen availability in the High Compost System contributed to the observed difference in biomass.

Achieving Critical Mass: Understanding Determinants of Successful Technological Innovations

KOBINA A. ACQUAY

Under the supervision of Dr. Aija E. Leiponen
Department of Applied Economics and Management

This paper aims to understand the implications of both the internal and external factors firms face as they attempt to develop successful technological innovations. This paper introduces a new conceptual framework for illustrating market outcomes as firms launch new innovations into the market. This framework, referred to in the paper as the Market Entry Model, provides an intuitive approach to understanding the potential profits firms face when launching new products into a market. The formal theory behind the Market Entry Model is described in detail in the paper and case study analyses are provided to illustrate the model's effects first-hand. The goal of this paper is to provide a comprehensive analysis of the internal and external dynamics facing firms that choose to develop innovative products and discuss how understanding such dynamics is essential to the success of technological innovations.

International Organ Trade: A Review of Organ Markets Abroad and Analysis of Changing Perceptions of Body Sovereignty in the United States

GENEVIEVE N. COLLINS

Under the supervision of Dr. Lucinda E. G. Ramberg
Department of Anthropology

Transplant tourism has emerged as a global phenomenon, affording rich patients, often economically elite from the developed world, the opportunity to procure healthy organs for transplantation from living unrelated donors. Although granting the opportunity of extended life for patients with end stage organ failure, commercial organ trade is a highly exploitive enterprise that worsens the existing socioeconomic health inequalities between the buyer and seller. This study examines the social, political, and economic characteristics of international organ markets involved in transplant tourism, and explores the barriers experienced by governments attempting to create effective domestic organ procurement strategies. Data from the 2012 General Social Survey is analyzed in order to determine intergenerational differences in the American publics perceptions of body sovereignty. Significant intergenerational differences in views on body sovereignty were found, and these results are used to predict the future employment of transplant tourism in the United States, and the acceptance of a global market in which humans have the right to sell their organs.

International Constraints of Development in Haiti: The Prospects of Agriculture and Food Security

PATRICIA DANIEL

Under the supervision of Dr. Shelley Feldman
Department of Development Sociology

In light of the recent earthquake, a cholera outbreak, and many other natural and man-made devastations, Haiti topped the priority list of the entire international community in terms of relief aid. In response to these, many long-term development plans were formulated in order to steer Haiti towards a path of sustainable development. However, despite significant international intervention, Haiti continues to assume the title of the "poorest country in the western hemisphere." The goal of my thesis is to understand, given internal conflicts, why international interventions in Haiti have not led to sustained development. I argue that historically foreign investment in Haiti has instead been accompanied by increased poverty and food insecurity because a majority of foreign policies did not work in favor of the country's agricultural economy. I also hypothesize that despite their adverse consequences over various political regimes, similar interventionist policies remain in place today. Through a historical comparative analysis, I found substantial support for my claim that structural adjustment policies, framed by the liberalization agenda of international institutions such as the World Bank and the International Monetary Fund, have led Haiti to neglect its agricultural economy in favor of its weak and foreign dominated manufacturing sector. My findings show that international pressure on the Haitian state and shifts in policies were substantially responsible for the deterioration of the country's agriculture and its dependence on food imports. Even after the earthquake, when agriculture suddenly emerged in national and international development plans, the same trade liberalization policies that led to the decline of agriculture remain in place. I conclude by suggesting that their market based approaches to agricultural change is unlikely to satisfy Haiti's desperate need to boost national production and secure food self sufficient.

Phones, Friends, and Flu Shots: How Phone Attachment Can Affect Pain Perceptions

STEPHANIE A. FRIEDMAN

Under the supervision of Dr. Jeffrey T. Hancock
Department of Communication

Some mobile phone owners, especially younger ones, rarely separate from their device. Little is known, however, about the psychological effects of being this connected to their cell phone. We used an established phone attachment subscale and two novel visual items for measuring social network perceptions to explore phone attachment and its relationship to perceptions of social support. We found that smartphone owners and younger individuals are more attached to their phone than regular phone owners and older individuals, respectively, and that attached individuals estimate their social network to be larger than less attached individuals. We also examined how activating phone attachment behavior affects perceptions of a stressful situation; specifically, we examined

how separating people from their phone while they waited in line for a flu shot affected their perceptions of how painful the shot would be. Consistent with attachment theory, we found that high phone attachment individuals anticipated more pain than low phone attachment individuals. This research enhances our understanding of how cell phones act as attachment objects. Our results indicate that the presence of one's cell phone, relative to having one's phone removed, can help a person feel more connected to loved ones and more at ease in stressful situations.

Custodial Grandparent Families in New York State; An Examination of the Effects of Race and Education

ZOE P. GREENFIELD

Under the supervision of Dr. David L. Brown
Department of Development Sociology

The American family unit has been moving away from the conventional forms of its traditional past. Recently, single mothers, same-sex couples, and co-habiting families have become more prevalent and have gained the attention of researchers, policy makers, and the popular media. However, another family structure, grandparents who are responsible for their grandchildren (hereon referred to as custodial grandparent families) is also on the rise. While still relatively rare (about 1.3 % of all households), an increasing proportion of United States children are being raised in these family circumstances. These new American family units have different dynamics than other family units, and consequently, have different needs. This study seeks to identify factors that are associated with the likelihood that a family will be characterized as a custodial grandparent family. Custodial grandparent families have been shown as more likely to be non-Hispanic Black as well as less educated, but it is unclear which of these factors has a stronger association with a household being a custodial grandparent household. This paper expands previous research by examining whether racial differences in the likelihood of being a custodial grandparent family persist after educational attainment and other factors such as gender and age of householder are accounted for. I use the Integrated Public Use Microdata Series to extract a data set disaggregated by household type from the 2010 five-year American Community Survey. I use logistic regression to determine factors associated with being a custodial grandparent family compared with other households including children under 18 years of age. The overall finding is that custodial grandparent families are more likely to be Black even after controlling for education, age, and gender of the household head. Additionally, I conducted interviews with custodial grandparents, a custodial grandchild, and organizations providing services to them in Ithaca, New York to delve further into their stories. I believe that this new family-type has the potential to demonstrate important connections between family life, wellbeing, structural inequality, and social policy.

Female Schooling During "That Time of the Month": An Evaluation of How Sanitation Infrastructure Affects Female Achievement in a Sub-Saharan Setting

JULIA C. KRAUSS

Under the supervision of Dr. Parfait Eloundou-Enyegue and Dr. Sarah C. Giroux
Department of Development Sociology

If you're a girl, "that time of the month" can provide a myriad of problems. For most girls living in the developed world, having their period, while a nuisance, does not pose a threat to their health or educational attainment. However, in some parts of the world girls are unable to attend school during menstruation. Due to a lack of sanitation infrastructure and social stigmas and taboos, girls from various cultures may miss school during their periods. Previous studies indicate that a lack of proper sanitation infrastructure negatively affects female achievement in school via its impact on school attendance. This study draws upon data from the *Etudes et Perspectives d'Emploi au Cameroun* survey to understand the relationship between school sanitation and infrastructure, measured by the presence of separate toilets for males and females and access to running water in schools, and student achievement, measured by grade repetition, student rankings, and student grades, in the urban areas of Cameroon, Younde and Kribi. Surprisingly, this study found that there is not a significant difference between female and male educational achievement, regardless of the type of school sanitation infrastructure. Furthermore, while access to water in schools had a positive effect on all students' achievement, the effect of separate toilet facilities for students remained statistically insignificant, except for the effect it had on female rankings. Therefore, based on this group of urban schools, females are performing better in schools than the previous literature would suggest and so the relationship between sanitation infrastructure and students' outcomes is uncertain.

The Role of Telehealth to Meet the Medical Needs of Farmworkers in Rural Areas

HANNAH A. PURKEY

Under the supervision of Mary Jo Dudley, Senior Extension Associate
Department of Development Sociology

Even though everyone needs a doctor from time to time, not everyone has the ability to obtain one. Individuals living in rural areas have a much greater chance of not being able to obtain the health access they need and desire. Of those living in rural areas, some populations, such as migrant farmworkers, experience greater challenges in gaining access to consistent and quality care. Telehealth has been presented as a possible solution to addressing these inequalities in care. This paper examines the experience of health care service providers working in rural health care as they integrate telehealth and telemedicine technologies into their scope of practice. It examines previous research and highlights some of the benefits and challenges of the new technology and its approach to medical care. The focus is on the use of telehealth within the New York State Migrant Telehealth Network, founded by Finger Lakes Community Health located in Penn Yan, New York. The research examines the experiences of four different health centers currently at different stages of

program development. In addition to exploring the unique challenges that rural health care centers experience in the course of adopting this technology this study also highlights how telehealth is especially beneficial to migrant farmworkers. Finally, this thesis outlines lessons learned from the experience of these participating health centers and presents them in a framework that could benefit other community health organizations as they implement telemedicine practices.

Investing in Low Volatility: A Global Strategy

CONSTANCE QIAN

Under the supervision of Dr. David T. Ng
Department of Applied Economics and Management

The traditional risk vs. return investment model has been increasingly challenged by poor performance of risky equities. As investors seek alternative strategies with lower beta (market risk), a variety of investment products have been introduced to decrease variance within portfolios. If it is indeed true that lower risk strategies can achieve higher risk-adjusted returns, they could significantly change portfolio management going forward.

This study examines the value of low volatility strategies at a fundamental level. Due to distinct regional characteristics, ETFs in the U.S., developed ex-U.S., and emerging markets are evaluated separately. Observations are made on the historical relationship between low volatility strategies and other market factors. In addition, the methods in which the ETFs are put together are analyzed in order to predict whether patterns will continue in the future.

The findings indicate that, although low volatility ETFs have historically offered better riskadjusted returns, such performance is inconsistent across time periods and regions. Thus, trends cannot be expected to persist in the upcoming years. Furthermore, this study attributes past outperformance to natural market tendencies rather than the "low volatility" aspect of the products.

Attribution of Group Values from Linguistic Cues: Effects of Value Salience

KRISTEN M. STEVES

Under the supervision of Dr. Poppy L. McLeod
Department of Communication

This study addresses the general question of how people make attributions about group-level values through linguistic cues. Connecting individual attribution processes to value-based language provides another area for exploration. This research also examines how perceivers' value priorities affect those attributions, as well as their perceptions and attitudes towards the group behavior. These questions are explored through a laboratory study in which participants—whose value systems were measured—listen to audio recordings of simulated business group discussions, in which linguistic cues and value-based language were manipulated. Responses related to attributed values,

perceptions, and attitudes provide connections that necessitate further research in these social and cognitive processes.

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